GRADE 12
DIPLOMA EXAMINATION

Chemistry 30

June 1991

Alberta
EDUCATION

GRADE 12 DIPLOMA EXAMINATION
CHEMISTRY 30

DESCRIPTION

Time: 2½ hours

Total possible marks: 70

This is a **closed-book** examination consisting of **three** parts:

PART A has 49 multiple-choice questions each with a value of one mark.

PART B has seven numerical-response questions each with a value of one mark.

PART C has three written-response questions for a total of 14 marks.

A chemistry data booklet is provided for your reference.

NOTE: The perforated pages at the back of this booklet may be torn out and used for your rough work. **No marks** will be given for work done on the tear-out pages.

GENERAL INSTRUCTIONS

Fill in the information required on the answer sheet and the examination booklet as directed by the examiner.

You are expected to provide your own scientific calculator.

Carefully read the instructions for each part before proceeding.

DO NOT FOLD EITHER THE ANSWER SHEET OR THE EXAMINATION BOOKLET.

The presiding examiner will collect your answer sheet and examination booklet and send them to Alberta Education.

JUNE 1991

PART A

INSTRUCTIONS

In this part of the examination, there are 49 multiple-choice questions each with a value of one mark. All numbers used in the questions are to be considered as the result of a measurement.

Read each question carefully and decide which of the choices **best** completes the statement or answers the question. Locate that question number on the separate answer sheet provided and fill in the space that corresponds to your choice. **Use an HB pencil only.**

Example		**Answer Sheet**

This diploma examination is for the subject of

A.   Biology
B.   Physics
C.   Chemistry
D.   Mathematics

| A	B	C	D
①	②	●	④

If you wish to change an answer, erase your first mark completely.

> NOTE: The perforated pages at the back of this booklet may be torn out and used for your rough work. **No marks** will be given for work done on the tear-out pages.

DO NOT TURN THE PAGE TO START THE EXAMINATION UNTIL TOLD TO DO SO BY THE PRESIDING EXAMINER.

1. Which statement correctly describes the energy changes when a solid changes to a liquid at constant temperature?

    A. The potential energy remains constant and the kinetic energy increases.
    B. The potential energy increases and the kinetic energy remains constant.
    C. The potential energy increases and the kinetic energy decreases.
    D. The potential energy decreases and the kinetic energy decreases.

2. When 100 g of steam at 100°C change to water at 100°C, there is

    A. a release of 33.5 kJ of energy
    B. a release of 226 kJ of energy
    C. an absorption of 33.5 kJ of energy
    D. an absorption of 226 kJ of energy

3. Which of the following does **not** have a standard enthalpy of formation of zero?

    A. $CO(g)$
    B. $Co(s)$
    C. $Ca(s)$
    D. $Cf(s)$

4. When solid ammonium chloride, $NH_4Cl(s)$, is added to water, the solution feels cooler to the touch. Which statement **best** describes this observation?

    A. The dissolving of $NH_4Cl(s)$ is exothermic.
    B. $NH_4Cl(s) \longrightarrow NH_4^+(aq) + Cl^-(aq) \qquad \Delta H = -33.6$ kJ
    C. Heat is released as $NH_4Cl(s)$ dissolves.
    D. $NH_4Cl(s) + 33.6$ kJ $\longrightarrow NH_4^+(aq) + Cl^-(aq)$

5. The change that is predicted to release the largest quantity of energy is

    A. $C(s) + O_2(g) \longrightarrow CO_2(g)$

    B. $2NO_2(g) \longrightarrow N_2O_4(g)$

    C. $^{14}_{6}C \longrightarrow ^{\ 0}_{-1}e + ^{14}_{7}N$

    D. $CO_2(s) \longrightarrow CO_2(g)$
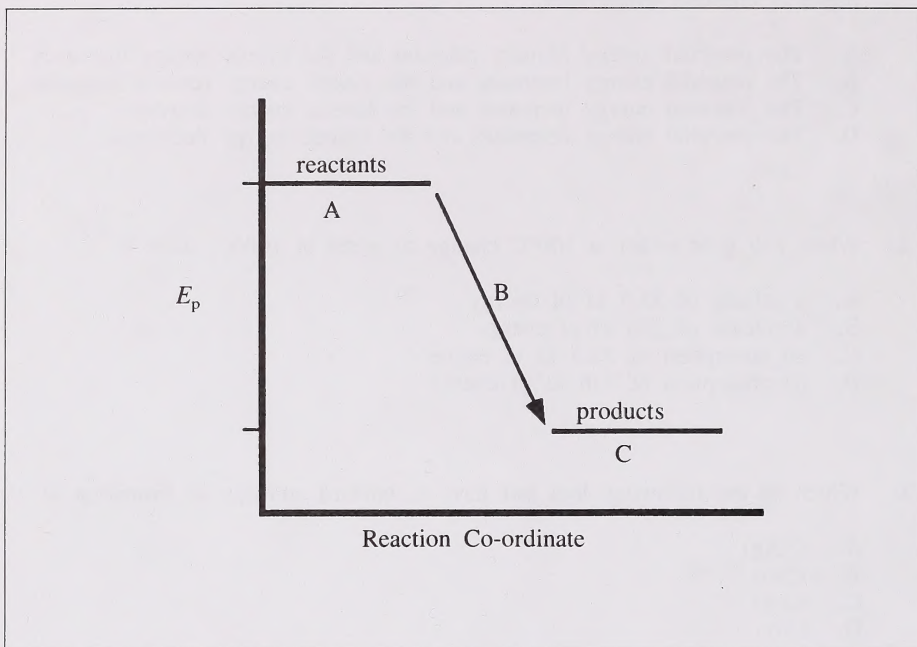
6. The diagram could apply to a nuclear reaction or a chemical reaction. However, in the

    A. nuclear reaction, section B will be much larger than in the chemical reaction
    B. nuclear reaction, section B will be much smaller than in the chemical reaction
    C. nuclear reaction, section C must be above section A
    D. chemical reaction, section C must be above section A

7. The heat of reaction per mole of ammonia in the reaction
    $NH_3(g) + HCl(g) \longrightarrow NH_4Cl(s)$ is

    A. -452.8 kJ/mol
    B. -360.6 kJ/mol
    C. -176.0 kJ/mol
    D. $+176.0$ kJ/mol

Room temperature	21.00°C
Mass of reactant	1.23 g
Molar mass of reactant	56.5 g/mol
Initial calorimeter temperature	18.45°C
Final calorimeter temperature	24.85°C
Mass of water in calorimeter	86.00 g

8. According to this information, the molar heat of reaction is

 A. −42.2 kJ/mol
 B. −50.2 kJ/mol
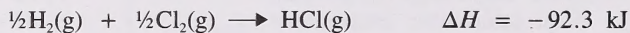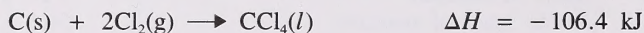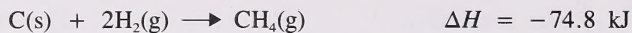 C. −63.2 kJ/mol
 D. −106 kJ/mol

In a calorimetric experiment, a student compared two samples of different metals. When each sample was placed into a calorimeter, these data were obtained:

	Metal X	Metal Y
Mass (metal)	5.00 g	5.00 g
Δt (metal)	45.00°C	45.00°C
Δt (calorimeter)	1.25°C	1.85°C

9. Assuming that the same calorimeter was used for both metals, the student should conclude that

 A. the total heat lost by metal X was greater than that lost by metal Y
 B. the specific heat of metal X was less than that of metal Y
 C. the substance in the calorimeter was most likely water
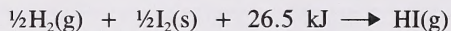 D. metal Y has a higher boiling point than metal X has

$$C(s) + 2H_2(g) \longrightarrow CH_4(g) \qquad \Delta H = -74.8 \text{ kJ}$$

$$C(s) + 2Cl_2(g) \longrightarrow CCl_4(l) \qquad \Delta H = -106.4 \text{ kJ}$$

$$\tfrac{1}{2}H_2(g) + \tfrac{1}{2}Cl_2(g) \longrightarrow HCl(g) \qquad \Delta H = -92.3 \text{ kJ}$$

10. The heat of reaction for $CH_4(g) + 4Cl_2(g) \longrightarrow CCl_4(l) + 4HCl(g)$ is

A. -123.9 kJ
B. -216.2 kJ
C. -273.5 kJ
D. -400.8 kJ

$$\tfrac{1}{2}H_2(g) + \tfrac{1}{2}I_2(s) + 26.5 \text{ kJ} \longrightarrow HI(g)$$

$$\tfrac{1}{2}H_2(g) + \tfrac{1}{2}I_2(g) \longrightarrow HI(g) + 5.0 \text{ kJ}$$

11. The heat of reaction for the change $I_2(s) \longrightarrow I_2(g)$ is

A. $+21.5$ kJ
B. $+26.5$ kJ
C. $+31.5$ kJ
D. $+63.0$ kJ

12. In the combustion of hydrogen, the amount of energy released depends on the

A. molar mass of hydrogen
B. amount of hydrogen used
C. initial temperature of hydrogen
D. oxidation number of hydrogen

$$6CO_2(g) + 6H_2O(l) + 2802.7 \text{ kJ} \longrightarrow C_6H_{12}O_6(s) + 6O_2(g)$$

13. The amount of $CO_2(g)$ required to react so that 2.2×10^3 kJ are absorbed is

    A. 7.6 mol
    B. 6.0 mol
    C. 4.7 mol
    D. 1.3 mol

14. The amount of heat required to change 54.1 g of water at 25.0°C to steam at 130.0°C is

    A. 143 kJ
    B. 140 kJ
    C. 23.8 kJ
    D. 11.4 kJ

15. A student observed that a solution spilled in the garage at home was reacting with a zinc container. The solution could be expected to

    A. be a reducing agent
    B. turn litmus red
    C. have a high pH
    D. feel slippery

16. Four unknown solutions labelled I, II, III, and IV were tested and these data were obtained:

Indicator	I	II	III	IV
thymol blue	green	yellow	green	orange
methyl orange	yellow	orange	yellow	red
thymolphthalein	colorless	colorless	slight blue	colorless

    The acidic solution(s) is/are

    A. I only
    B. II only
    C. II and IV
    D. I and III

17. Three unknown solutions labelled I, II, and III were tested and these data were obtained:

| Solution	Conductivity	pH
I	good	8.5
II	good	1.4
III	poor	5.4

The acidic solution(s) is/are

A. I only
B. I and II only
C. I and III only
D. II and III only

18. Which equation is an acid-base neutralization reaction?

A. $2HCl(aq) + Mg(s) \longrightarrow MgCl_2(aq) + H_2(g)$

B. $LiOH(s) + HBr(aq) \longrightarrow LiBr(aq) + H_2O(l)$

C. $2HNO_3(aq) + 3H_2SO_3(aq) \longrightarrow 2NO(g) + H_2O(l) + 3H_2SO_4(aq)$

D. $Pb(NO_3)_2(aq) + 2KI(aq) \longrightarrow PbI_2(s) + 2KNO_3(aq)$

19. Which statement regarding the molecule $X\!-\!\underset{}{\overset{O}{\diagup}}\!-\!H$ is true?

A. If the O-H bond is strong, the molecule could be a strong acid.
B. If the X-O bond is weak, the molecule could act as a base.
C. If the X-O bond is strong, the molecule could act as a strong base.
D. If both the X-O and O-H bonds are strong, the molecule could act as a strong acid or a strong base.

20. Which statement for the system
$H_2PO_4^-(aq) + CH_3COO^-(aq) \leftrightharpoons CH_3COOH(aq) + HPO_4^{2-}(aq)$
is correct?

A. $H_2PO_4^-(aq)$ acts as a base.

B. Equilibrium favors the products.

C. $CH_3COO^-(aq)$ acts as an acid.

D. $HPO_4^{2-}(aq)$ acts as a base.

21. Which equation is the first step in a reaction of a polyprotic species?

   A. $OH^-(aq) + HCl(aq) \longrightarrow H_2O(l) + Cl^-(aq)$

   B. $HOOCCOOH(aq) + 2OH^-(aq) \longrightarrow OOCCOO^{2-}(aq) + 2H_2O(l)$

   C. $HMo(aq) + OH^-(aq) \longrightarrow Mo^-(aq) + H_2O(l)$

   D. $OH^-(aq) + H_2CO_3(aq) \longrightarrow HCO_3^-(aq) + H_2O(l)$

22. The strongest acid listed is

   A. $H_3X(aq)$

   B. $H_2X^-(aq)$

   C. $HX^{2-}(aq)$

   D. $X^{3-}(aq)$

23. An unknown 0.10 mol/L acid solution turns bromocresol green to yellow, orange IV to yellow, and methyl orange to red. The unknown solution could be

   A.   ammonium chloride
   B.   carbonic acid
   C.   ethanoic acid
   D.   nitric acid

24. As a solution becomes more acidic, the pH

   A.   decreases and the $[OH^-(aq)]$ decreases
   B.   increases and the $[OH^-(aq)]$ increases
   C.   decreases and the $[H_3O^+(aq)]$ decreases
   D.   increases and the $[H_3O^+(aq)]$ increases

25. The equilibrium $H_2O(l) + HBb(aq) \rightleftharpoons H_3O^+(aq) + Bb^-(aq)$ exists when bromothymol blue indicator is added to water. Which statement is correct?

   A.   When KOH(aq) is added, the [HBb(aq)] increases and the solution turns yellow.

   B.   When HCl(aq) is added, the $[H_3O^+(aq)]$ increases and the solution turns yellow.

   C.   When HCl(aq) is added, the equilibrium is shifted toward the reactants and the solution turns blue.

   D.   When KOH(aq) is added, the equilibrium is shifted toward the reactants and the solution turns yellow.

26. Solution I is red in phenol red and colorless in phenolphthalein. Solution II is pink in phenolphthalein and yellow in alizarin yellow R. The $[H_3O^+(aq)]$ is about

    A. two times higher in solution I than in solution II
    B. two times higher in solution II than in solution I
    C. 100 times higher in solution I than in solution II
    D. 100 times higher in solution II than in solution I

27. A hydronium ion always forms when

    A. a metallic ion dissolves in water
    B. a hydrogen ion becomes hydrated
    C. a base dissolves in water
    D. an acid reacts with a base
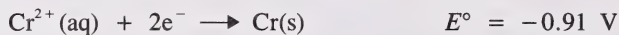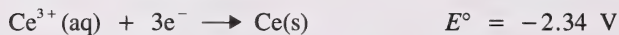
Use the following reaction to answer question 28.

$$HSO_3^-(aq) + H_2BO_3^-(aq) \leftrightharpoons SO_3^{2-}(aq) + H_3BO_3(aq)$$
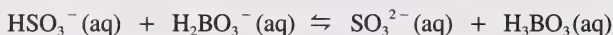
28. A conjugate acid-base pair in this system is

    A. $H_3BO_3(aq)$ and $HSO_3^-(aq)$

    B. $HSO_3^-(aq)$ and $H_2BO_3^-(aq)$

    C. $H_3BO_3(aq)$ and $H_2BO_3^-(aq)$

    D. $HSO_3^-(aq)$ and $H_2O(l)$

29. In 0.10 mol/L HCOOH(aq), the species present in highest concentration is

    A. HCOOH(aq)
    B. $HCOO^-(aq)$
    C. $H_3O^+(aq)$
    D. $OH^-(aq)$

30. The equivalence point of this titration occurs at point

Volume of acid added
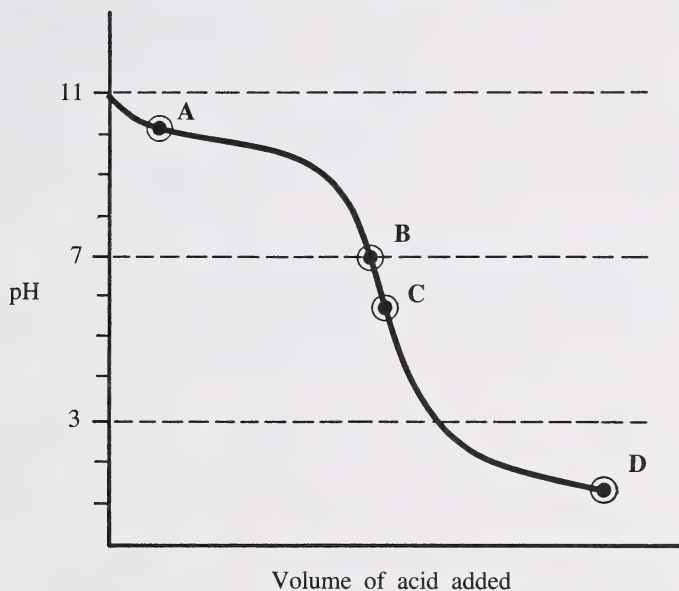
31. The [OH$^-$(aq)] in a solution made by mixing 50.0 mL of 0.200 mol/L HCl(aq) with 200 mL of 0.300 mol/L HCl(aq) is

A. 2.80×10^{-1} mol/L
B. 2.80×10^{-4} mol/L
C. 3.57×10^{-11} mol/L
D. 3.57×10^{-14} mol/L

32. Reduction is indicated by a

A. loss of electrons
B. decrease in oxidation number
C. positive ion getting a higher positive charge
D. negative ion becoming neutral

33. In the reaction
$4Zn(s) + 10H^+(aq) + NO_3^-(aq) \longrightarrow NH_4^+(aq) + 4Zn^{2+}(aq) + 3H_2O(l)$,
the reducing agent is

A. Zn(s)
B. H$^+$(aq)
C. Zn^{2+}(aq)
D. NO$_3^-$(aq)

$$Ce^{3+}(aq) + 3e^- \longrightarrow Ce(s) \qquad E° = -2.34 \text{ V}$$

$$Cr^{2+}(aq) + 2e^- \longrightarrow Cr(s) \qquad E° = -0.91 \text{ V}$$

34. When an operating electrochemical cell is constructed on the basis of these half-reactions, the oxidizing agent gains

A. six less electrons than the reducing agent gains
B. two more electrons than the reducing agent loses
C. three more electrons than the reducing agent loses
D. the same number of electrons as the reducing agent loses

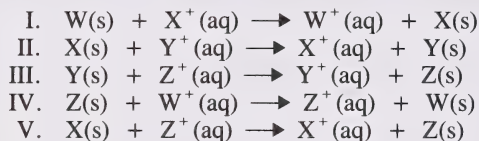Use the following incomplete half-reactions to answer question 35.

$Cl_2(g) \longrightarrow 2Cl^-(aq)$	$+1.36$ V
$Fe^{3+}(aq) \longrightarrow Fe^{2+}(aq)$	$+0.77$ V
$Cr^{2+}(aq) \longrightarrow Cr^{3+}(aq)$	$+0.41$ V
$Zn^{2+}(aq) \longrightarrow Zn(s)$	-0.76 V
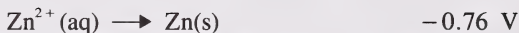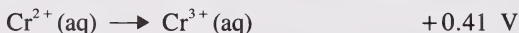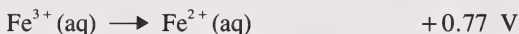
35. Which species loses electrons?

A. $Cl_2(g)$

B. $Fe^{3+}(aq)$

C. $Cr^{2+}(aq)$

D. $Zn^{2+}(aq)$

36. Which equation is a redox reaction?

A. $Ag^+(aq) + Cl^-(aq) \longrightarrow AgCl(s)$

B. $Pb^{2+}(aq) + 2I^-(aq) \longrightarrow PbI_2(s)$

C. $CO_2(g) + Ca(OH)_2(aq) \longrightarrow CaCO_3(s) + H_2O(l)$

D. $Cl_2(aq) + 2Br^-(aq) \longrightarrow Br_2(aq) + 2Cl^-(aq)$

37. When acidified $Cr_2O_7^{2-}$(aq) is used in a redox titration to oxidize Sn^{2+}(aq) solution, the molar ratio of oxidizing agent to reducing agent that must be used to reach the equivalence point will be

    A.   1:1
    B.   1:3
    C.   1:14
    D.   14:3

38. Using acidified 0.20 mol/L $Cr_2O_7^{2-}$(aq), a student titrated a solution of $Sn(NO_3)_2$(aq) of unknown concentration. In the titration, 34.0 mL of oxidizing agent were required to react with 43.0 mL of the reducing agent. What was the concentration of $Sn(NO_3)_2$(aq)?

    A.   0.17 mol/L
    B.   0.47 mol/L
    C.   0.53 mol/L
    D.   0.76 mol/L

39. The standard reduction potential of a metallic ion is -0.30 V. Which of these metals will be most easily oxidized by this ion?

    A.   Cd(s)
    B.   Co(s)
    C.   Pb(s)
    D.   Cu(s)

40. Which half-reaction has a negative $E°$ value?

    A. $Fe^{2+}(aq) \longrightarrow Fe^{3+}(aq) + e^-$

    B. $Br_2(l) + 2e^- \longrightarrow 2Br^-(aq)$

    C. $Au^{3+}(aq) + 3e^- \longrightarrow Au(s)$

    D. $Cr(s) \longrightarrow Cr^{2+}(aq) + 2e^-$

A student observed the reactions between four different metals and the solutions of their ions, and then recorded these ''spontaneous'' reactions.

$$\text{I.} \quad W(s) + X^+(aq) \longrightarrow W^+(aq) + X(s)$$
$$\text{II.} \quad X(s) + Y^+(aq) \longrightarrow X^+(aq) + Y(s)$$
$$\text{III.} \quad Y(s) + Z^+(aq) \longrightarrow Y^+(aq) + Z(s)$$
$$\text{IV.} \quad Z(s) + W^+(aq) \longrightarrow Z^+(aq) + W(s)$$
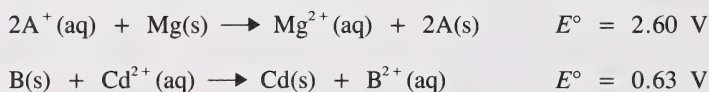$$\text{V.} \quad X(s) + Z^+(aq) \longrightarrow X^+(aq) + Z(s)$$

41. If equation I is correct, which equation did the student record incorrectly?

A. II
B. III
C. IV
D. V

42. Which oxidizing agent is the strongest?

A. $Cl_2(g)$

B. $Br_2(l)$

C. $Cl^-(aq)$

D. $Br^-(aq)$

$$2A^+(aq) + Mg(s) \longrightarrow Mg^{2+}(aq) + 2A(s) \qquad E° = 2.60 \text{ V}$$
$$B(s) + Cd^{2+}(aq) \longrightarrow Cd(s) + B^{2+}(aq) \qquad E° = 0.63 \text{ V}$$

43. What is $E°$ for the reaction $2A^+(aq) + B(s) \longrightarrow 2A(s) + B^{2+}(aq)$?

A. 3.23 V
B. 1.97 V
C. 1.26 V
D. 0.80 V

44. Which of these would react spontaneously with Co(s) but not with $H_2(g)$?

    A. $H_2O(l)$

    B. $Ni^{2+}(aq)$

    C. $Ca^{2+}(aq)$

    D. $Br^-(aq)$

45. The balanced net ionic equation for the reaction that occurs when a piece of potassium is dropped into a container of water is

    A. $2K(s) + 2H_2O(l) \longrightarrow H_2(g) + 2K^+(aq) + 2OH^-(aq)$

    B. $K(s) + 2H_2O(l) \longrightarrow H_2(g) + K^+(aq) + 2OH^-(aq)$

    C. $K(s) + H_2O(l) \longrightarrow H^+(aq) + K^+(aq) + OH^-(aq)$

    D. $2K(s) + H_2O(l) \longrightarrow H^+(aq) + 2K^+(aq) + OH^-(aq)$

Use the following reactions to answer question 46.

$Ir(s) + Tl^+(aq) \longrightarrow$ no reaction

$Ir^{3+}(aq) + Re(s) \longrightarrow$ no reaction

$3Tl^+(aq) + Y(s) \longrightarrow 3Tl(s) + Y^{3+}(aq)$
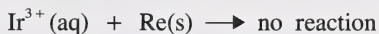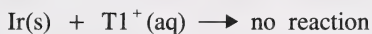
46. In these reactions, the strongest oxidizing agent is

    A. $Tl^+(aq)$

    B. $Y^{3+}(aq)$

    C. $Ir^{3+}(aq)$

    D. $Re^{3+}(aq)$

$$Cu^{2+}(aq) + X(?) \longrightarrow Cu(s) + X^{2+}(aq) \qquad E° = 1.10 \text{ V}$$

47. Element X(?) is

    A. Al(s)
    B. Ca(s)
    C. Zn(s)
    D. Hg(l)

    _____

48. An electrolytic cell is one in which the

    A. net potential of the reaction is positive
    B. oxidation-reduction reaction is spontaneous
    C. energy is converted from electrical to chemical
    D. chemical energy is changed to electrical energy

49. Up to 25 per cent of the yearly production of iron is used to replace iron objects that must be discarded because of corrosion. The corrosion of iron is caused mainly by

    A. an electrolytic process
    B. an electrochemical process
    C. a reaction between iron and water only
    D. an endothermic neutralization process

YOU HAVE NOW COMPLETED PART A. PROCEED DIRECTLY TO PART B.

PART B

INSTRUCTIONS

In this part of the examination, there are seven numerical-response questions each with a value of one mark. All numbers used in the questions are to be considered as the result of a measurement. Read each question carefully and answer each question.

Use the answer sheet provided.

For calculation questions, record your answer to **three** digits by writing it in the boxes and filling in the corresponding circles. Note: Fill in only **three** of the four boxes and circles; the decimal point on the answer sheet determines which three boxes and circles you should use.

Sample Calculation Question and Solution

Answer Sheet

The mass in grams of silver produced when 0.0220 mol of silver nitrate reacts with excess copper is _____ g. (Give your answer to three digits.)

$$mass_{Ag} = 0.0220 \text{ mol} \times 107.87 \text{ g/mol}$$
$$= 2.37314 \text{ g}$$
$$= 2.37 \text{ g (rounded to three digits)}$$

Record 2.37

For correct-order questions, record your answer by writing it in the boxes and filling in the corresponding circles. Note: Fill in all **four** boxes and circles.

Sample Correct-order Question and Solution

Answer Sheet

When the following subjects are arranged in alphabetical order, the order will be __ , __ , __ , __ .

1. Mathematics
2. Chemistry
3. Biology
4. Physics

Answer 3, 2, 1, 4

Record 32.14

Use an HB pencil only.

If you wish to change an answer, erase **all** traces of your first answer.

START PART B IMMEDIATELY.

1. $H_2O(s) \longrightarrow H_2O(l)$ at 0°C

2. $H_2O(s)$ at $-60°C \longrightarrow H_2O(s)$ at 0°C

3. $H_2O(l) \longrightarrow H_2O(g)$ at 100°C

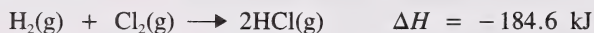4. $H_2(g) + \frac{1}{2}O_2(g) \longrightarrow H_2O(g)$ at 25°C

1. When the magnitude of energy changes for one mole is ranked from highest to lowest, the order is _____ , _____ , _____ , _____ .

2. The energy gained by 250 mL of water when the temperature increases from 22.9°C to 36.8°C is _____ kJ. (Give your answer to three digits.)

Use the following reaction to answer question 3.

$$H_2(g) + Cl_2(g) \longrightarrow 2HCl(g) \qquad \Delta H = -184.6 \text{ kJ}$$

3. If the hydrogen chloride produced when 9.23 kJ of energy are released is dissolved to form 1.5 L of solution, the pH will be _____ . (Give your answer to three digits.)

1. 0.10 mol/L $H_2S(aq)$
2. 0.10 mol/L $NaOH(aq)$
3. 0.10 mol/L $H_2SO_4(aq)$
4. 0.10 mol/L $HOOCCOOH(aq)$

4.   When the solutions are listed in order of increasing pH, the order
is _____ , _____ , _____ , _____ .

5.   If hydrochloric acid is continuously added to a solution that contains both
$Na_2CO_3(aq)$ and $Na_2SO_3(aq)$, the following reactions will occur:

1. $H_3O^+(aq) + SO_3^{2-}(aq) \longrightarrow HSO_3^-(aq) + H_2O(l)$

2. $H_3O^+(aq) + CO_3^{2-}(aq) \longrightarrow HCO_3^-(aq) + H_2O(l)$

3. $H_3O^+(aq) + HSO_3^-(aq) \longrightarrow H_2SO_3(aq) + H_2O(l)$

4. $H_3O^+(aq) + HCO_3^-(aq) \longrightarrow H_2CO_3(aq) + H_2O(l)$

The order in which these reactions occur is _____ , _____ , _____ , _____ .

6.   The voltage produced by an electrochemical cell made of $Fe(s)$ and $Fe^{2+}(aq)$ reacting
with $Ag(s)$ and $Ag^+(aq)$ is _____ V. (Give your answer to three digits.)

7. Using acidified potassium dichromate solution, a student performed several titrations and recorded these results:

	Trial 1	Trial 2	Trial 3	Trial 4
Final burette reading (mL)	16.8	29.9	43.1	13.4
Initial burette reading (mL)	2.1	16.8	29.9	0.2

The average volume of potassium dichromate that the student should use in her calculations is _____ mL. (Give your answer to three digits.)

YOU HAVE NOW COMPLETED PART B. PROCEED DIRECTLY TO PART C.

PART C

INSTRUCTIONS

In this part of the examination, there are three written-response questions for a total of 14 marks. All numbers used in the questions are to be considered as the result of a measurement.

Write your solutions in the examination booklet as neatly as possible.

Your solutions **must show all** pertinent explanations, calculations, and formulas. Full marks will be assigned **only** to those solutions that **show** all pertinent explanations, calculations, and formulas.

All numerical answers must be given to the appropriate number of significant digits.

NOTE: The perforated pages at the back of this booklet may be torn out and used for your rough work. **No marks** will be given for work done on the tear-out pages.

START PART C IMMEDIATELY.

1. You are given a paraffin candle and are asked to determine the heat of combustion
    of paraffin in J/g. Outline briefly **in sentence form** the **step-by-step** experimental
    procedure you would follow, using the equipment listed below, to obtain the
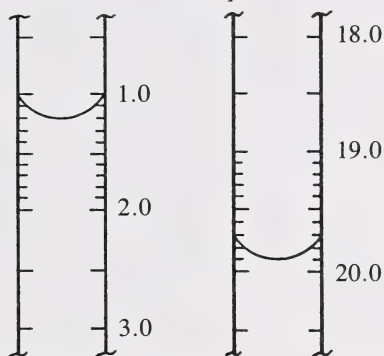   necessary data.

<div align="center">

Equipment

</div>

glass beaker and water   paraffin candle
electronic balance   thermometer (°C)
matches   beaker tongs

Use the following information to answer question 2.

The diagram shows the initial and final burette readings of the NaOH(aq) used to titrate 25.0 mL of 0.206 mol/L HCl(aq).
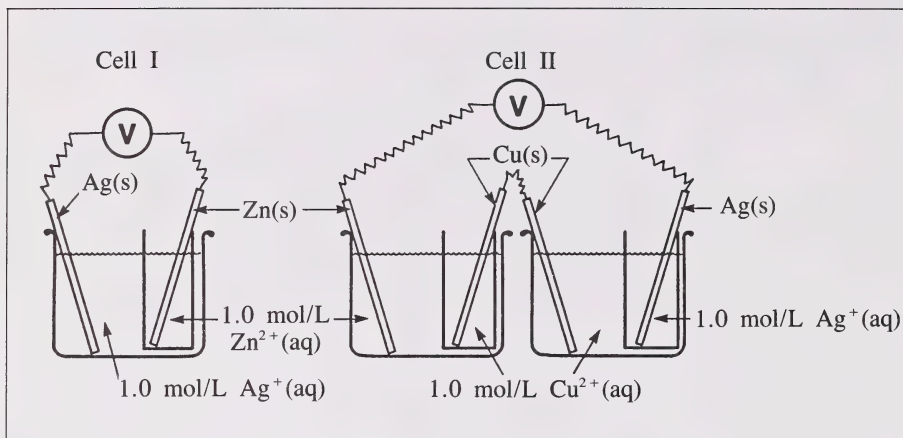

2. a. Write a balanced chemical equation for this reaction and calculate the concentration of NaOH(aq).

    b. If air had been present in the tip of the burette at the beginning of the titration but was not present at the end, would the calculated experimental value for the NaOH(aq) concentration in part 2. a. be higher, the same, or lower than the actual value?

        Why?

Use the following information to answer question 3.

Cell I   Cell II

Ag(s)   Cu(s)   Ag(s)

Zn(s)

1.0 mol/L
Zn²⁺(aq)   1.0 mol/L Ag⁺(aq)

1.0 mol/L Ag⁺(aq)   1.0 mol/L Cu²⁺(aq)

3. **a.** Why does cell I produce the same voltage as cell II?

b. What is the net $E°$ value for cell II?

c. What is the purpose of the porous cup?

**YOU HAVE NOW COMPLETED THE EXAMINATION. IF YOU HAVE TIME,
YOU MAY WISH TO GO BACK AND CHECK YOUR ANSWERS.**

FOR DEPARTMENT USE ONLY

M1 ☐

M2 ☐

M3 ☐

M4 ☐

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CHEMISTRY 30

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